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NUMBER 4
JULY-AUG 1961
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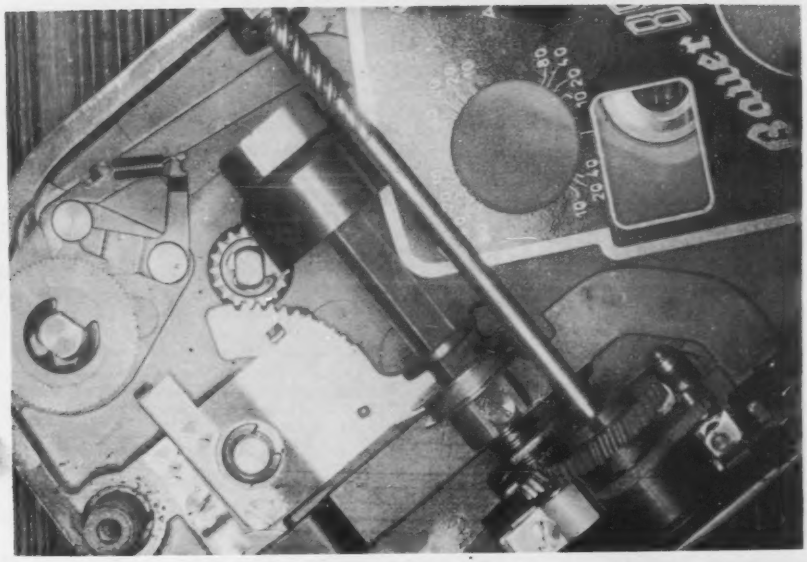
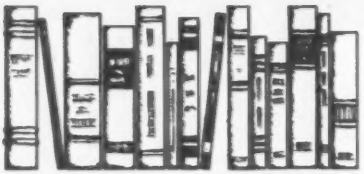
the CAMERA CRAFTSMAN



In this issue:

APERTURE COMPENSATION

SONIC WELDING MACHINE



BOOK SHOP

Here are useful additions to your library of technical material. This department will regularly offer suggestions for new books you may wish to acquire. Any reference books, whether or not here listed, photographic or otherwise, will be located for you and may be purchased through National Camera Servi-Shops Supply, Box 174, Englewood, Colorado.

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VOLUME 7
NUMBER 4

JULY-AUG 1961

The Periodical of Photo Technology for Camera Repairmen

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NATIONAL CAMERA REPAIR SCHOOL, LITHO IN U.S.A.

CONTENTS

Features

Automatic Aperture Compensation ____ 8
New Sonic Welding Machine ____ 10
Education at Home ____ 11

SPT Section

Measuring and Testing Lenses ____ 1

Departments

A Point To Ponder ____ 3
Reports From The Craftsman ____ 5
Recent Graduates ____ 6
Study Shots ____ 7
Book Review ____ 12
Your ServiShop Questions ____ 13
Help Wanted ____ 13
Hi There ____ 14
Our Students Speak ____ 15
Bellows ____ 17

This Month's Cover

SHUTTER DRIVE MECHANISM OF BAUER "88" MOTION PICTURE CAMERA

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A Point to Ponder

By SAMUEL L. LOVE

America has always seemed to be a nation of "joiners". Of course, all men gain a sense of security by "belonging". Whether it is the Garden Club or the American Medical Association; the Boy Scouts or the Kiwanis; the Citizens for Eisenhower or the Society for the Preservation and Encouragement of Barber Shop Quartet Singing in America; each of us has his pet organization with which he would like to be associated.

Some organizations are pompous or even amusing. At least one cartoonist earns a living by doing nothing but spoofing woman's clubs: their speakers, their aspirations and their activities. Many feel that all organizations are a waste of time; perhaps because of one bad experience.

But invariably we judge the worth of an organization by what we get from that organization. So some types of people immediately develop a dislike of organizations. For it is a virtual rule that the value you get from an organization is in proportion to what you give to it. Generally, if you give little, you get no more.

Naturally, there are many types of organizations with which you will come into contact as a Camera Repairman.

One is the "trade" association. A trade association is one in which members are engaged in the same business. They join together in an effort to increase their business know-how, their management skill and their success potential. Typical is the Master Photo Dealers and Finishers' Association. It does a tremendous job. This organization is established primarily for dealers and finishers.

It has a good place for our field, camera repair, too. There is a modest amount of technical involvement in a trade association. The primary concern is with business problems, management and economics.

The other type of organization is the technical society. This type of organization should be closely tied in with your particular field. Then it can be most valuable to you. The only camera repair organization like this today is the Society of Photo Technologists. The Society is relatively unconcerned about business problems. That's what a trade organization is for. No, the tech-'

Cont. page 4

SYNCHRO CONTACTS P-C 3 mm			Price
	to be riveted into shutter	SCR 1	.75
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	for Compur, Prontor, Pronto and Vario shutters spring ⅝" long metric screw M 1.4	SCR 3	1.45
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	for Rolleiflex Automat etc. spring ½" long wire 4" long metric screws M 1.4 black leather plate	SCR 6	2.10
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	End	Plastic		
	P-C 3 mm male	black	SCR 13	.30
		ivory	SCR 14	.30
	P-C 3 mm female	black	SCR 15	.75
		ivory	SCR 16	.75
	double prongs (US household plug)	ivory	SCR 17	.45

REPAIR LEADS

	P-C 3 mm 12" long, ready for mounting			
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	P-C 3 mm male	black	SCR 18	.35
		ivory	SCR 19	.35
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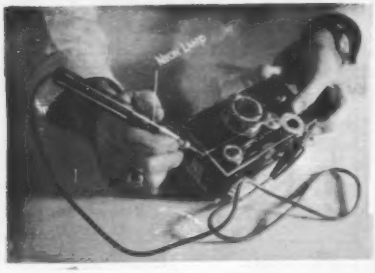

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Point to Ponder-Cont. from page 3

nical society, is concerned with helping you become a better practitioner of your art.

Chances are that it will be some time before there are enough independent camera repair shops to create a strong trade association. There will always be the need to exchange technical information, however, even with a small group. That's the value of the Society of Photo Technologists. The modest organization of Franchised National Camera ServiShops provides a form of trade association. Every camera repair shop operator should be a member of the Master Photo Dealers and Finishers' Association.

Can you gain by working with the Society of Photo Technologists? Yes, whether you are working for yourself or for someone else as a Camera Repairman.

Though I said "gain" there are some limitations. Invariably, you can gain no more than you give. Are you willing to share your ideas and support the organization of which you are a part? Then you can indeed find that S. P. T. is a tremendous asset to you. Naturally, you can gain just by knowing people who are involved in work similar to yours. Such a Society is not a bank. It is no place to hoard your interest or your knowledge. Rather, it is a clearing house for those having similar interests. Will you give of yourself, offer your thoughts and ideas with little thought of return? Then you can honestly share in the gold mine of material that exists in the minds of your fellow members. There will then never be the opportunity for you to say, "I belonged to that outfit but I quit. I never got anything out of it!"

NCRS PICNIC

National Camera Repair School held its annual picnic at The Shetland Pony Ranch in the mountains above Evergreen, Colorado.

Everyone enjoyed the delicious food, including the water melon which the children really loved.

Topping off the afternoon was a baseball game, women against the men. Of course, you know who won--The Men!

Reports FROM THE CRAFTSMEN

I can't thank you enough for the fine magazine, the Camera Craftsman. I have every copy in a binder, and refer to them often.

Melvin Nechvatal
Lancaster, Wis.

So far, the course seems very well thought out. If the rest is stated as clearly as the first six lessons, the school is to be congratulated. . .

George G. Toft
Chicago, Illinois

This is just a note to state that I am very pleased with your instruction books. I have shown them to a man already in the trade (for many years) and he tells me that they are very good.

R. Sheret
Canada

Although much of the material in the lessons so far are familiar to some extent, I find them very interesting and I feel that I am learning a lot of things that I hadn't previously given much thought to. The lessons are thought-provoking and I really enjoy them.

L. J. Trudel
Cupertino, Calif.

This will be my first letter to you since starting the course last November. I find the course very thorough and, although I am only in the early stages of study, I am already taking in repairs. Customers thus far have been well satisfied with my work.

Roy D. Ogden
Ontario, Canada

I find that NCRS training is very thorough and comprehensive and that I have gained considerably, both educationally and financially since enrolling. It has given me a purpose in life.

Raymond E. Warnke
Grand Rapids, Mich.

What started as a hobby is becoming almost a full time job.

Ed Cantin
Delmar, N. Y.

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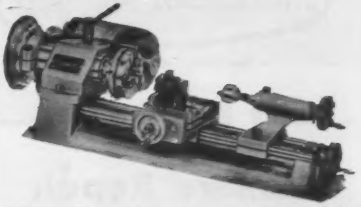

Basic unit consists of the precision lathe and all components necessary to set up drill press, milling machine, tool and surface grinding machine, hand drill, grinding and polishing machine. Also includes motor, upright steel drill press post, universal 3 jaw (reversible) self centering Cushman type lathe chuck, 3 jaw Jacobs type 1/4" capacity drill chuck, pivoting tool post, 2 dead centers. Face plate, lathe dog, grindstone arbor, Allen wrench, easy to follow instruction manual. Unimat basic unit comes handsomely packaged in sturdy wood storage chest. Complete basic unit, priced $129.50

Items 1 through 5 are included in the basic unit. Items 6 through 9 are accessories. Write for illustrated literature and price list.

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Please furnish me with complete information about your training program.

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Address

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Congratulations TO NEW NCRS GRADUATES

Graduation time represents the culmination of studies completed over a period of from one to three years. In many cases this achievement was made under heavy pressures from regular job and family responsibilities. All of these NCRS graduates deserve the highest praise for the diligent attention and unflagging work that went into their course of training.

William H. Helman	Canada
Raymond Boss	Connecticut
Lorenzo Hall	Florida
L. P. Green	New Mexico
Bob Jones	New York
Lawrence Taylor	New York
Howard Koontz	Ohio
Doyce Croy	Oklahoma
Roland Curtis	Washington
Certificate of Completion:	
W. A. Patterson	Canada

"LIGHT UP AND LIVE"

If you someday face a futuristic firing squad equipped with Infrared aiming equipment - and they ask your last wish - take a cigaret. It'll be dashingly devil-may care; and it'll save your life.

Experts at Aerojet - General Corporation's Avionics Division in Azusa, California, point out that the Infrared (IR) equipment's incredible instinct for heat radiation would aim at the lighted cigaret with pinpoint accuracy.

In fact, they point out, where a carnival sharpshooter would draw applause by knocking a cigaret from his pretty partner's mouth at 10 paces - he'd really bring down the house if he had IR equipment.

With IR he could hit the burning tip from several hundred yards - and do it blindfolded or in the dark.

And far beyond electronic Annie Oakley capabilities and surveillance satellite missions, Infrared technology is burgeoning into a multitude of applications for industry, medicine, food processing and a broad range of other civilian applications.

It is a usable device on anything that has temperature above absolute zero (273 degrees centigrade). Even ice gives off heat radiation easily detected by IR.

So if you ever face that IR equipped firing squad, take the cigaret and light up nonchalantly. Only be sure and stand sideways!

study shots

HERE IS WHERE NCRS STUDENTS LEARN

These are pictures of students in the shops they have set up for their training in camera repair.

John R. Logan
Pinellas Park, Florida

Don E. Knapp
Colorado Springs, Colorado

Vincent Amendola
Brooklyn, New York

Jimmie Williams
Miami, Florida

S. E. Staples
Sioux Falls, South Dakota

Paul Fortin
Indianapolis, Indiana

J. M. Zimmerle
Howell, Michigan

Mary Miyakawa
San Jose, California

John E. Gilbert
Bell Gardens, California

AUTOMATIC APERTURE COMPENSATION

Automatic aperture compensation for extreme extension of the focusing mount of a lens, long wanted by photographers for close-up work, has been incorporated by Carl Zeiss, Oberkochen, in three lens designed for Zeiss Ikon's Contarex (single-lens-reflex) camera.

The three Zeiss lenses in which automatic compensation is provided are the 35-mm., f/4 Distagon and 50-mm., f/2 Planar, and the new 55-mm., f/1.4 Planar.

New 55mm., f/1.4 Zeiss Planar

Traditionally, the speed of a lens at any specific f/ number on the aperture scale is conditional upon the lens being focused at infinity. When the lens is focused on a closer subject, the actual speed of the lens is reduced (less than the f/ number engraved on the aperture scale). The lens, having been extended by focusing, is farther from the film in the camera and, consequently, less light reaches the film.

Because of the latitude and speed of many modern films, the factor can be safely disregarded as long as the lens is not focused near the close-up range. When the lens has been extended beyond a certain point, particularly in making close-ups and hyper-close-ups, or when color film which has comparatively limited latitude is used, this loss of light becomes important. This is not generally known and, therefore, exposure is frequently not correct.

In such instances, the photographer must either calculate the true, or effective, f/

50mm., f/2 Zeiss Planar Lens

stop of the lens or an exposure increase factor. Either result indicates how much the exposure time of the picture must be increased to avoid underexposure.

The calculation, which is done with standard formulas, is not complicated but is time-consuming and slows down picture-taking. It is also subject to human error. Therefore, photographers have long wanted compensation built into lenses to eliminate tedious mathematics and time waste; and to make it possible to use exposure meters with greater accuracy for close-up photography.

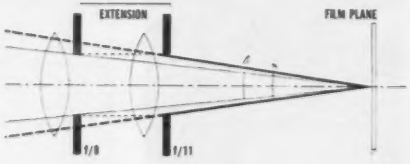

Diagram above shows how aperture compensation mechanism operates in 50-mm, f/2 Planar lens. Amount of light admitted is equal to angle alpha, assuming that lens is focused at infinity and stopped down to f/11. When lens is extended by focusing on an object 12" away, amount of light admitted is reduced to angle beta. Without automatic compensation devices, this would necessitate a 1.6 increase in exposure time, to approximately f/8.

Automatic compensation was introduced into these lenses because they can be focused on subjects at very short distances from

Cont. page 9

Aperture Compensation-Cont. from page 8

the camera. The mechanism, as might be expected because of the complex nature of the problem, is quite ingenious. It involves increasing the opening of the lens diaphragm aperture as the mount is extended to permit the admission of a calculated increase in the amount of light.

The diaphragm is operated by means of a pin which projects beyond the inner mounting of the lens. If this pin is moved along a circular arc, the diaphragm is either opened up or stopped down. The pin runs along a spiral-shaped groove in the outer cylinder of the lens. When the lens is focused, this outer cylinder is displaced in the direction of the object to be photographed, the diaphragm pin is rotated slightly and the aperture opened by the required compensation value.

Compensation is made at all apertures, except when the lens is wide open, when it is not feasible.

All three lenses equipped with automatic compensation also have unusually wide focusing ranges. The 35-mm. Distagon, a seven-element lens, focuses from infinity to 31/2" from the front of the lens. The 50-mm. Planar, a six-element lens, focuses from infinity to 8" from the lens.

The new 55-mm. Planar, a seven-element lens, focuses from infinity to 14" from the front of the lens.

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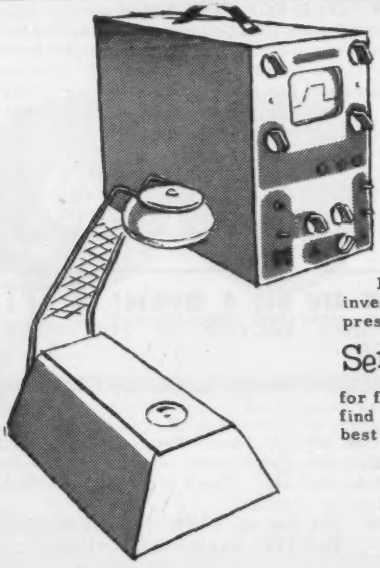

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$35.00

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NEW SONIC WELDING MACHINE

Sonoweld, a newly developed machine, welds steel and aluminum together without difficulty.

Any welder can tell you, its always been impossible to join such dissimilar metals as aluminum and stainless steel by regular methods of torch or electric arc. The aluminum melts and runs before the steel softens under heat.

The device looks a little like an electric spot welder, but there the resemblance ends. First, a metal finger presses the steel and aluminum firmly together. Then comes a high pitched metallic squeal as the pressure finger vibrates at 15,000 cycles a second. It's similar to a very high note on a violin. The welding is over in less than two seconds.

One immediate use for sonic welding is in the manufacture of thermocouples used for measuring temperatures electrically.

Like many other important finds, sonic welding was discovered by accident. It was first used in 1950 by Aeroprojects. Martin Co. is using the new welding process to join the stainless steel inner shell of an atomic-electric generator to the aluminum outer shell. A generator built by this method was launched aboard a navigational satellite on June 29th.

A NEW FIELD FOR RESEARCH

It is not known exactly how sonic welding works. What happens when two dissimilar metals or materials flow together in this manner? How do the molecules and atoms--perhaps the electrons and nuclei of the atoms--behave? The answers to such basic questions may produce some vitally important practical results.

Sonic welding, opens up a fascinating new field of possibilities in metallurgy. It can join highly dissimilar metals, or alloys of metals, together.

The future may bring many manufactured articles that are welded by sound.

If you are not a member of SPT,...

THE NEXT SECTION OF THIS ISSUE IS MISSING

The Society of Photo-Technologists section of the Camera Craftsman is sent only to members of the Society. Don't miss the valuable articles in this section!

Write: The Society of Photo-Technologists
Box 174, Englewood, Colorado

SPT
THE SOCIETY OF PHOTO-TECHNOLOGISTS

Measuring and Testing LENSES

Continued from May-June issue.

by G. Barnstedt

In most cases, it is important to ascertain the focal plane of the lens under test, which means that the object must be placed at an infinite distance. It is generally impossible to use heavenly bodies as an object, and so a suitable object on the earth is selected, at a sufficiently great distance; to eliminate errors resulting from the fact that the object does not in fact lie at an infinite distance, certain conditions must be adhered to.

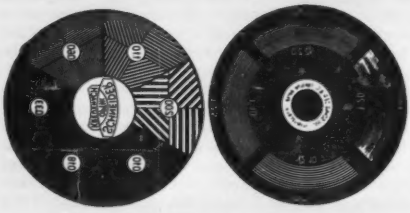

Fig. 18 Two collimator test charts.

If z is the distance of the real test object from the front focal point, z' the distance of the image from the rear focal point of the test lens and f' its focal length, so $z\,z' = f'^2$. If it is required, for instance, that $z' < \frac{f'}{10,000}$, it follows that $z > 10,000\ f'$.

For example: f' = 100 mm; $z' < 0.01$ mm
$z' > 1$ km.

The use of a collimator is the most accurate and simplest method. This consists of a well-corrected telescope lens, in the focal plane of which the transilluminated test chart is placed; it thus forms both for the observer and for the lens under test an apparent object at infinity.

It is very important to set the collimator correctly, which involves placing the test chart exactly in the focal plane of the collimator lens. To do this, either a real test object must be used at a sufficiently great distance, or an already-adjusted collimator must be used. The adjustment will be most precise when a good-quality plane mirror is used and auto-collimation employed.

If the test chart is not placed exactly in the focal plane of the collimator lens, but is displaced by a distance z_k, the image will lie at a distance z' from the focal point of the test lens. Both values are related as shown by the equation

$$\frac{z_k}{z'} = \frac{f_k^2}{f'^2}$$

Formula 18

f_k is the focal length of the collimator lens, f' that of the test lens. Should again z' be and if, for instance:

f' = 100 mm; z' = 0.01 mm,
f_k = 620 mm
z_k must be < 0.38 mm

Generally, there are no difficulties involved in adjusting a collimator accurately, and when carefully adjusted the degree of inaccuracy to be expected will be about 10 times less.

From the formula, however, one can see that inorder to keep the focusing error as small as possible, a collimator will be required with a focal length greater than that of the lens under test.

Object at Finite Distance

In some cases, it is necessary to have a test object at a finite distance. For distances up to about 30 times the focal length of the lens under test, it is comparatively easy to depict real objects of adequate dimensions, since they can still be accommodated on the optical bench. Difficulties will arise with large distances, when

Cont. page 2

Testing Lenses, Cont. from page 1

the image will also have to be of a suitable size. Real objects can then no longer be realized in the laboratory; however, it is possible to produce virtual objects at any distance required on the optical bench, by removing the test lens from the focal plane of the collimator and moving it towards the collimator lens. Provided that accurate data concerning this lens are known, it is possible to calculate the position of the real image, which has now become the object for the lens under test.

Definite of the Focal Plane

Here we will describe only the assessment of the focal plane with the lens diaphragm fully open or stopped-down only slightly. The determination of the focal plane under special conditions will be described in the chapter on measurement of the Correction Distance.

Difficulties occur in making precise measurements, because the focal plane has not been specifically defined, on account of various image faults. Every zone of the lens yields a different image point for the axis alone (spherical aberration), and it is necessary to find, within the arising caustic, the plane in which the best image is obtained (Fig. 19).

On the other hand, the caustic has a different form for each different color of light, resulting in a different position of the plane which yields the best image. This necessitates the finding of a plane, for focusing by white light, which yields the best image by the combined action of light rays of all colors and from each zone of the lens. These relationships lead to a whole series of difficulties.

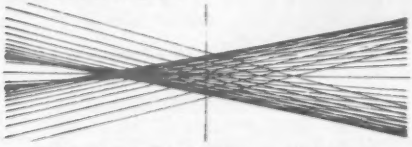

Fig. 19 Path of rays in vicinity of focal point of a lens.

What exactly is meant by the "best image"? It depends on whether the lens is focused for the highest resolving power or for the highest contrast. These will be obtained on differing focal planes. The plane of maximum resolution is distinguished by the fact that the grid spacing, at which the separate lines can only just be distinguished, is the smallest. At the plane of maximum contrast, however, the brightness differences between the light and dark portions of a given grid will be greatest. The position of the plane of maximum contrast depends again on the grid spacing of the grid under examination and comes closer to the plane of maximum resolving power as the grid spacing becomes closer.

In visual methods, it is also possible to focus on the "color change". Light or dark boundaries often possess a red or green margin, according to whether they are in front of or behind the plane. The best focal plane is where the color change occurs. This plane generally coincides with the plane of maximum contrast with relatively large grid spacing. Exact quantitative values concerning this relationship have not been discovered so far.

A further possibility is to focus for freedom from parallax. To do this, the image of a line or illuminated slit is made to coincide with a single line or a cross-hair. By moving the eye laterally to-and-fro, it is possible to check whether the image and the cross-hair are in the same plane. In this event both elements remain in register, whereas otherwise they will appear to move laterally towards each other.

In which plane should the photographic plate now be placed? This depends on the subject of the picture and on the negative material used. If it is necessary to copy an extremely detailed original on to special high-resolution, high-contrast emulsion, such as the Kodak MR Plate or the Agfa Mikrat Plate, the most suitable procedure would be to focus on the plane of maximum resolving power.

In pictorial photography, it is not generally quite so important to reproduce such ultra-fine details, since the resolving power of the lenses is generally greater than that of the normal emulsion. It is much more important to reproduce light-dark contours with the maximum contrast, and in color photography, to avoid color fringing. The normal practice is therefore to focus on the color-change which is generally the same as the maximum-contrast plane when the grid spacing is relatively large.

Even though chromatic aberrations are extremely well corrected in modern lenses, precision measurement reveals differences resulting from differences in the spectral-energy distribution of the illumination (daylight or tungsten light), as well as with differences in the spectral sensitivity of the receiver (orthochromatic or panchromatic film, the human eye, or photo-cell). This must be taken into consideration when relating visual or photo-electric estimation in photographic exposures.

All of these remarks concern the determination of the focal plane under the conditions of actual photographic practice. However, if it is necessary to compare the measured constants with the calculated values, the measurements should be made under the same conditions as were assumed for the computation; when dealing with color filters, monochromatic light should be used if possible. This will eliminate one

difficulty, but the other - the search for the best focusing plane within the caustic - still remains. Unfortunately, immediate comparison with the computed value is not at all possible. What is computed is the point of the caustic, which corresponds to a height of incidence of the entering ray, h = O.

The most suitable focal plane can only be judged when the computation of the spherical aberration is given and therefore the shape of the caustic is known; it thus corresponds approximately to the point of closest 'bunching' of the rays. In this case, the test object selected for measurement is a sufficiently fine transilluminated aperture: an artifical star. Focusing should be performed visually so the image of this point shows the smallest nucleus, which corresponds to the narrowest part of the caustic. In this way it is possible to arrive at values which are most suitable for comparison with the computation.

The way in which the measurement of the aperture-difference can also enable the Gauss plane to be determined, will be described in the chapter concerning "Measurement of State of Correction".

It should be mentioned that in some cases it will be necessary to measure the size of the image formed by the lens under test. This size also depends, however, on the position of the focal plane, as the latter was set at random for measurement. Inorder to eliminate this source of error, Abbe suggested working within the rear telecentric ray-path, so that, by placing an aperture disc at the forward focal point, only that bundle of rays is used for measurement. The central rays pass through this focal point and so also pass through the image space parallel to the axis.

The adoption of these conditions unfortunately results in certain limitations, which might be undesirable from other points of view. In the first place, image size must not exceed that of the exit pupil of the lens. Secondly, only a selected zone of the lens aperture is used for measurement, while in most cases it is necessary to take measurements at full aperture or at a specific aperture setting. The differences between the results achieved by these two methods may be larger than the measuring tolerance.

Photographic Methods.

If the lens is to be used later for photographic purposes, the most effective method of determining the focal plane is by verifying the plane in which the best image is formed on a photographic emulsion. An emulsion should be selected, which has a color-sensitivity and gradation which correspond to those of commercially-available types of film, but which also possesses a comparatively high resolving power. A series of exposures of the test chart should be made on plates coated with this emulsion, moving the plate after each exposure through a precisely-determined distance along the optical axis.

The plate should be moved sufficiently far to ensure that the first and last exposures are significantly less sharp than the intermediate exposures. With the aid of a microscope or a strong magnifying glass, the negatives should be examined and that revealing the best contrast should be selected. Naturally, it should be possible to repeat the positioning of the emulsion which resulted in the best image. This technique provides the greatest degree of certainty with regard to external conditions, but the actual accuracy of measurement is relatively small. It is possible to judge that, for instance, with a lens of 50 mm focal length and a relative aperture of 1:2.0, the degree of error involved in determining the focal plane may be about ±0.02mm. It is frequently difficult to decide which of the several successive exposures is actually the best. Since this method is rather long-drawn-out, on account of the photographic processes involved, it should only be employed in special cases.

Visual Methods

In addition to photo-electric testing techniques, the visual methods are most suitable for speedy measurement. Here, the image of the test-object produced on the ground-glass screen (or the real aerial image) is viewed under a microscope or with a very powerful magnifying glass. The magnification should not be more than X50, however, inorder to enable focusing on the plane of maximum contrast.

The use of a ground-glass screen is preferable to focusing on the aerial image; the depth-of-field range is smaller and the image is clearer and more uniform, since in the other case dirt on the collimator lens and on the field lens of the microscope eyepiece can prove distracting. To prevent the grain of the ground-glass screen from being too noticeable, the screen should be rotated or swung. Naturally, the microscope must be focused carefully on the surface of the screen; the aperture should be at least as large as that of the lens to be measured, since otherwise not all the rays will enter the microscope, despite the ground-glass screen.

The set-up for measurement can of course be reversed. Through a telescope focused on infinity, a test object is viewed in the image space of the lens, and is then moved until it appears sharp in the telescope. The test object then lies at the focal point of the lens. In this case it is advantageous to use a cross-hair as a

Cont. page 4

Testing Lenses, Cont. from page 3

test object, and focus for freedom from parallax. There will be no gain in accuracy with this method, however.

Both testing techniques can also be used for auto-collimation. In the first method, the collimator should be replaced by a mirror; in the second method, the mirror should be placed in the focal plane of the lens under examination. Since the lens aberrations will be doubled in degree, the accuracy of this method should be twice as great. However, in actual practice, this exactitude will never be completely attained.

A practical observer will be able to assess the position of the focal plane to an exactitude of approximately 0.005 to 0.01 mm, when several tests are made with the above-mentioned lens.

The disadvantage of this method is the fact that no specific marginal conditions can be produced, since the focusing depends upon uncontrollable physiological facts. It may happen that another observer determines a focal plane which is displaced relative to the focal plane as seen by the first observer by an amount which is several times greater than the actual inexactitude of measurement. This error may be even greater when the measurement is performed with a different apparatus.

Photo-electric Methods

The photo-electric method is the most exact way of determining the focal plane. One method which has been proved successful for series-measurement is that which employes as a test object a sector-star with 256 sectors.* (See Fig. 20). The image of this star is made to coincide with a second star, which has been rotated by the width of one sector. In this way, the dark sectors of the image fall upon the light sectors of the interceptor star, and vice-versa. A powerful illuminant should be employed. When the interceptor star is exactly in the focal plane, no light (or only very little) can pass; if it is positioned either in front of or behind the focal plane, the amount of light passed increases. This quantity of light should be measured with a photo-electric receptor connected to a galvanometer. By this method, the focal plane is determined by the minimum amount of light indicated on the measuring instrument. A more accurate assessment can be achieved by determining two planes of equal unsharpness before and behind the focal plane, as shown by equal deflections of the galvanometer. The required plane will midway between them, provided that the distance between the two unsharp planes does not exceed 2f'/1000. If necessary, it is possible to re-check by seeing how far one can go, reducing the distance step by step, so long as the central value remains in the same position. The larger this distance is, the greater will be the accuracy of focusing; in this way a focal plane is obtained at which (for a given mean value) the contrast is the greatest for the diffraction-constant provided by the star.

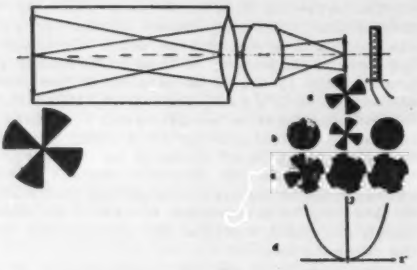

Fig. 20 Principle of photo-electric method of determining the focal plane. In practice, a star with 256 sectors is used instead of that illustrated.

a. Position of the interceptor star.
b. The image of the collimator star is sharp only in the focal plane; before and behind it is blurred
c. Both stars coincide in the focal plane: no light rays are allowed to pass.
d. Therefore the intensity indicated by the galvanometer is at its lowest in the focal plane.

The margin of error in establishing the focal plane is in this case about 0.5 to 1 μ with a lens 1:2.0, f' = 50 mm. With this degree of sensitivity, small changes in the conditions of measurement will make themselves immediately noticeable. For example, the temperature must not be allowed to vary beyond a specified amount. The advantage, however, is that all 'human error' is eliminated, so that all the conditions can be controlled carefully and reproduced. Since a very bright light-source is employed, the photo-cell used as a receptor will not require an amplifier.

(Cont. next issue)

We are indebted to Mr. Norman C. Lipton, Photographic Information Service, New York, N. Y.; and Jos. Schneider & Co., Optische Werke, Kreuznach, Germany for what we believe is a very informative article on "Measuring and Testing Lenses." -Ed.

Education At Home

Nine out of ten students get raises in pay when they graduate.

By Thomas J. Fleming

How many Americans are currently enrolled in correspondence courses?

"An estimated one and one half million", according to Dr. Robert Allen. Executive Director of the National Home Study Council, an organization of responsible private correspondence schools which are the standard-setting institutions for the entire field. There are some 500 correspondence schools in operation but only 48 are accredited by the Accrediting Commission of the NHSC-an indication of the Council's high standards.

When did correspondence schools start?

"In 1890. During the past 70 years over ten million students have taken courses. Men like Eddie Rickenbacker, David Sarnoff, Walter Chrysler, Senator Stuart Symington and Arthur Godfrey have paid tribute to the help they have received from correspondence schools."

Who is the average student today?

"There is no 'average' student, really. The young and senior retired citizens are as interested as employed adults in seeking new opportunities via home study. All want to get ahead."

Are there many women?

"Yes, and their numbers are growing. The facts prove education pays for women. A survey by the Women's Bureau showed women workers with high school educations averaged $2,181 a year. Those with less than eight years of schooling earned only $845 a year."

What are the most popular courses?

"Vocational and professional subjects which can be translated directly into more earning power. There are over 400 courses offered by our accreditied schools."

Do they really increase earning power?

"In one survey, nine out of ten correspondence school graduates reported they had gotten raises when they finished their course. The average increase was $25 a week. Forty-two per cent got promotions as well. You will find that high school courses and cultural courses are also increasing in enrollments."

Are correspondence schools common in other parts of the world?

"Yes. There are approximately a million students outside the U.S.A. In Sweden all vocational training is through correspondence. Russia maintains 22 correspondence centers

Cont. page 16

KENNEDY *all steel tool kits*

Positive spring stop prevents accidentally pulling drawer all the way out of cabinet. Spring catch can be released for quick removal of drawer.

The Kennedy line offers outstanding economy and value when fine tools are to be stored. Solidly built--reinforced by inside walls, which ensure rigidity and also support the drawers. The Model 520 has seven drawers sized to fit a wide variety of small tools. Compound drawer slides are equipped with positive stops which prevent spilling. Patented spring catches make it easy to remove drawers. All drawers are completely felt lined and can be drawn out their full length for a clear view. Slides work easily and smoothly without sagging even when heavily loaded. Adjustable partitions in each drawer except the bottom one.

Front panel slides underneath drawers when box is in use -- friction catch holds it there. Fits outside, holding drawers closed for carrying (locks with lid lock). Bright zinc plated fittings make attractive combination with brown ripple baked enamel finish. Dimensions: 20 x 8-1/2 x 13" Weight 27-3/4 lbs.

Till in Top	20 x 8-3/8 x 3-3/4
Four Drawers	8-5/8 x 7-1/2 x 1
One Drawer	8-5/8 x 7-1/2 x 2
One Drawer	18-1/4 x 7-1/2 x 1-1/2
Bottom Drawer	18-1/4 x 7-1/2 x 2-1/2

MODEL 520 **$31.95**

The #620 chest has the same rugged construction and time-saving convenience features as the #520 described above. Equipped with three drawers -- top one has four adjustable partitions. Dimensions: 20 x 8-1/2 x 13" Weight 26 lbs.

MODEL 620

$25.95

Till in Top	20 x 8-3/8 x 3-1/4
Top Drawer	18-1/4 x 7-1/2 x 1-3/8
Middle Drawer	18-1/4 x 7-1/2 x 2-3/8
Bottom Drawer	18-1/4 x 7-1/2 x 3-1/4

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WRENCHES

T 751-12P ***$3.50 ea.***

THESE WRENCHES are very effective tools for removing Lens and Retaining Rings that do not have built in Spanner Slots. You will not mar fine finishes or damage delicate lens mounts when you have a set of these wrenches in your kit. Available for any size diameter job.
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Popular sizes: 7/16, 1/2, 21/32, 3/4, 1-1/8, 1-1/4, 1-1/2, 1-3/4

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BOOK REVIEW

Exposure by W. F. Berg, D. Sc., Ph. D., F. R. P. S., The Focal Press, London and New York, Hard cover, 447 pages, $5.00.

W. F. Berg, who in 1936 joined the Research Laboratories of Kodak Ltd., is in charge of photographic emulsion studies and ranks as one of the worlds leading authorities on scientific theory underlying exposure.

His book is more than simply a guide to correct exposure. By using an exposure guide, it is almost impossible to plunge the extreme latitude of modern films. Processing, printing and enlarging will further compensate for errors and, in the last resort, the man in need can fall back on after-treatment, retouching or even the spray-gun. So in photography, just as in many other spheres, easy habits are replacing sound methods, and craftsmanship retreats before mass output. The result is a general decline in technical quality and even contempt for technique, which has become too easy to bother about.

Edward Weston, one of America's greatest photographers has amply demonstrated the outstanding results that can be achieved by exposing the picture properly in the first instance. His technique, which I do not seriously recommend for every day photography, was to secure the correct exposure and composition using an 8"X10" negative and then contact print on No. 2 paper only. As a result of this technique the finished photograph has an unbelievable realism that is hard to duplicate with photographs that have been subjected to corrective methods.

A definite line of argument runs through this volume. It stresses that we must judge all aspects of exposure from their results in the print.

The efficiency of the focal plane verses the leaf shutter is discussed. Shutter efficiency defined is the ratio of the amount of light passed by a shutter to that passed by a theoretically ideal shutter. This is illustrated for clarification, and two types of shutters are compared for efficiency.

This book will be useful to both photographer who considers himself primarily an artist, and the craftsman who respects good technique.

The new edition has required a certain amount of modification to bring some of the concepts of exposure into line with latest developments and newly accepted definitions. An entirely new chapter on the exposure of reversal materials has been added. But it is perhaps significant, that the original approach has proved itself fully justified for this key volume on photographic technique. ServiShop Supply, Box 174CC, Englewood, Colorado. -F. Platts

Your
ServiShops
QUESTIONS...

By Clair Schmitt, Editor

? ? ? ? ? NEED HELP ? ? ? ? ?

In this column I'll try to answer any camera repair questions you may have. Names will be withheld if requested. Address your questions to: Clair Schmitt, The Camera Craftsman, Box 174 CC, Englewood, Colorado.

How much initial tension should the hair spring in a Compur Shutter retard mechanism have?
Paul Fransisco

Use this procedure to put the proper tension on the Compur shutter retard mechanism hair spring: Hold the pallet out of engagement and completely disengage the retard lever. Turn the first gear clockwise until the spring unwinds to a diameter slightly larger than that of the first gear. At this point, hold the first gear and engage the retard lever, releasing the first gear as soon as engagement has started. Bring the retard lever into full engagement and then release the pallet lever, locking the retard mechanism in its correct position for installation. The retard lever will not completely disengage after it is installed in the shutter.

Would you say that by buying parts as needed to build an inventory is the best, even if it means a slow up in giving customers service?
Carl J. Wild

It is certainly my recommendation that you start building your inventory of parts by buying only as you need them. Always make sure that your customer understands the situation, however. If parts are needed and time is going to be involved, be sure to let him know the reason for the delay. No one can expect to stock every part nor will you ever have every part on hand.

Parts inventories can get out of hand quickly without care. Considering that the sale of parts averages 10 to 20% of your volume, a $1,000 inventory would only turn over one to two times a year on a $10,000 volume. Assuming business conditions remain normal, your parts inventory should not exceed 10 to 20% of your volume.

HELP WANTED

A card to NCRS Placement Service will bring more details about these opportunities. Include code number listed for opening that interests you.

177 Photo and Music Shop needs advanced student or camera repairman in modern establishment for full time employment. Miami, Florida.

01114 Need a good camera repairman to join our company and set-up a repair department or would consider financial support for a camera repairman wishing to start independent shop. Jacksonville, Florida.

0728 Repairman wanted to take full charge of repairs on photographic equipment. Must be able to repair all types of equipment. Tuscon, Arizona.

01214 Please furnish us with the name, address, and telephone number of any of your graduates who live in the Pittsburgh, Pa. area and are available for employment. We are willing to consider an advanced student.

1516 Repairman needed with several years experience in instrument and motion picture equipment maintenance and repair. Major airline. Yuma, Arizona.

121 Our company would appreciate applications from graduates of National Camera Repair School. North Hollywood, California.

01010 Well equipped modern shop needs two camera repairmen. Out-of-town inquiries invited. Top wages. New York, N.Y.

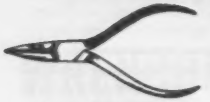
01014 Jacksonville, Florida firm needs experienced, bondable repairman to specialize in tape recorders and 16 mm sound projectors. Will consider someone willing to relocate.

01011 Established camera store in Framingham, Mass. with growing repair department wishes to employ an additional camera repairman able to handle the more complicated types of repair work. Pay commensurate with ability.

138 Motion picture camera repairman needed who has had experience on Mitchells, Bell and Howell, and Arriflex cameras. Our business is primarily in the motion picture field and we would want a man willing to specialize in this field. Hollywood, California.

Dealers --- Repairshops --- Service Departments
When you need repairmen, send details to NCRS Placement Service. Your needs will be listed here. Applications of interested repairmen will be sent for your consideration.

Lindstrom PLIERS



FLAT NOSE PLIERS

Size	4"	4½"	5"
Bright finish Cut jaws	$1.60	$2.05	$2.25
Bright finish Sm. jaws	1.90	2.05	2.25

HALFROUND NOSE PLIERS

Size	4½"	5"
Bright finish Smooth jaws	$2.10	$2.30

END CUTTING NIPPERS

Length	3½"	4"	4½"	5"
Bright finish	$2.20	$2.25	$2.30	$2.60

ROUND NOSE PLIERS

Size	4"	4½"	5"
Bright finish Sm jaws	$1.80	$2.00	$2.20

CHAIN NOSE PLIERS

Size	3½"	4"	4½"	5"
Bright finish Cut jaws		$1.85	$2.00	$2.15
Bright finish Sm. jaws	1.85	1.85	2.00	2.15

SIDE CUTTING NIPPERS

Size	3½"	4"	4½"	5"
Bright finish	$2.20	$2.20	$2.80	$2.80

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Hi There!

from Jan VanderBeek

Wow! The excitement around here lately, of course it means we'll be having our new building soon. Ground breaking was June 23rd and there were several cameras snapping and a few spades of good Colorado soil moved. Even Mr. John Cramer, President of the Englewood Chamber of Commerce attended. Over a period of just a few weeks, it has really taken on a good shape. Everyday something new is added.

Maybe having a new "face" will encourage a few more vacationers to visit us.

What with our vacation season in full swing here we're all busier than usual, but it's so nice to hear from all of you. We have had several visitors already. Mr. L. P. Green of New Mexico spent sometime in the shop. He was all set to start up a Camera Repair Shop when he left here two weeks later. Another student visited on his way home to California: Mr. Stephen and his bird "Muttsie". Muttsie spent most of the afternoon sitting in his cage on my desk making all sorts of noises at us strangers! Harvey Hunsucker, from Alaska, our 49th state, came to work in the shop for awhile to learn techniques on some new cameras.

Howard Koontz, Ohio, another of our graduates stopped by with his family to have his Analyzer checked over and to chat about Camera Repair business in his part of the country. Then Doyce Croy stopped in to visit too, and possibly will start a ServiShop in Oklahoma. It sure is nice visiting with people who are also in camera repair and interesting to listen to the different brogues from different parts of the country!

We also have two new additions to our "family at NCRS" Delores Elias as you may notice in the staff of the Craftsman. You will be seeing a lot of her work when you read this magazine. Lory Wells is our artist now and seems like everyday has a new cartoon on the wall above his desk! Things aren't dull around here ever, I'll guarantee!

An observation picked up from one of our TV stations which I thought was kind of cute, "Some women learn about music from the men who make overtures to them!" How about that!

See you next issue, in the meantime drop us a card!

Our Students Speak

At age sixty-five, I may have been the oldest student to enroll for the Camera Repair Course, in March of 1959. My principal thought in enrolling was to have additional income after retirement and a project to occupy my time.

Even the most elemental of the lessons proved intensely interesting. All the lessons were well presented, clearly written and easily understood. The practical work was a challenge, and each problem taught something of lasting value, to be used in future repair work.

At the end of last month, I made the trip to your School for personal instruction and to meet the people to whom I had been writing for several months. My visit was a wonderful climax to the Course, for it was the most pleasant and instructive trip I have ever had, or anyone could anticipate. Many of my questions were answered in the intensive work and training. Being something of a perfectionist, I was inclined not to have too much confidence in my ability. However, the few days with Bud Fowler and Dolph Hendrickson helped me a great deal. In fact, since returning home, I find I have little timidity in tackling any job that is offered. (Some 80 cameras have been repaired since the Course was started; and, having no complaints, I feel the work must have been acceptable.)

I want to say quite frankly that I was greatly impressed with the entire staff of the School. Meeting all of them and enjoying their companionship was a most gratifying and unforgettable experience. It isn't possible to single out any individual, for, from the boys in the mailing room, on up to yourself, everyone has a sincere desire to help the students, --and they work hard at it. I wish every student could realize just what a rare treat it is to spend the 50 hours at the School for the fellowship with the personnel, the personal attention, and individual teaching by the instructors and--last, but not least,

Cont. page 16

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Ends fuse when heated to form endless belt.

No. 11-174. 3/16" diam.—Per Ft. $0.15
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RUST REMOVER

4 oz. bottle $1.70

H-R Rust Remover is non-acid, absolutely harmless to the polished finish of fine parts. You may leave parts in this rust remover overnight. You may dip parts directly into the wide mouth 4 oz. bottle.

HARD ARKANSAS MOUNTED STONES

Length	Width	Each
3½"	1"	$3.00
4"	1⅛"	7.50
5"	1⅛"	9.00
6"	1⅛"	10.50

HARD PENKNIFE PIECES
(Approx. ½ the thickness of regular stones)

3"	1"	1.50

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HEAT

Take the "heat" ot. your camera repair department by sending problem repairs to your ServiShops Headquarters. Your ServiShops Headquarters stands ready to help with complete repair facilities and electronic testing equipment.

Send to be repaired to ServiShops Headquarters, Box 174 CC, Englewood, Colorado Your shipment acknowledged by return mail.

Tap-A-Line

IN YOUR WORKSHOP: Tap-A-Line permits you to plug in soldering irons, test lamps, flex shaft, other equipment. Has them all ready and available for immediate use.

IN YOUR STUDIO: Tap-A-Line is convenient for portable lights, flood lights, spot lights.

On Your Test Bench: Tap-A-Line will permit you to plug in all types of flash cords and have them at your finger tips.

Model TL 1 foot $2.00

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Dixon Miniaturized Tools

You've seen handy screw-holding drivers for the auto trade . . here's a miniature that's terrific in instrument and camera work. The jaws adjust automatically to hold screw straight and securely —no more stripped threads or lost screws. Ends awkward groping in hard to reach places. Set screw locks screw holder at any setting. Taper streamlining of screwholder section helps you get into tight places. $3.40

Knurled Nickel Plated Handles

Hexagon Aluminum Head

A companion miniature tool! The right tool for the job is essential in camera repair. This miniature Hand Drill eliminates fumbling with tools too large and bulky for precision work. Accommodates drills or taps in sizes 50 to 80 on twist drill gauge. You'll find it indispensable in your well equipped shop $3.50

A ServiShops PRODUCT

Education at Home-Cont. from page 11

through the country, plus a wide network of information centers where students can come in to discuss their lessons with instructors face to face."

Do many companies use correspondence courses in their training and up-grading programs?

"There are over 6,000 companies using employes' correspondence courses. Especially popular is the tuition refund plan where the company pays all costs when the student successfully completes the course."

Who needs correspondence schools the most?

"The 34,000,000 adult Americans who either have not graduated from high school or are not vocationally qualified for employment in today's technically complex industries. The country needs them, too. They are our untapped source of skilled manpower. For them, correspondence schools are a great second-and perhaps last-opportunity to get a good education."

How long does it take to complete a correspondence course?

"It depends entirely on the subject studied and the diligence of the student. Usually lessons come in groups of three to six. The student can complete them as quickly or as slowly as he likes. Being able to set your own pace is one of the great advantages of home study."

How much does a correspondence course cost?

"This also varies with the subject. A one-or two-year course in television repair may be $200-$300 while a four-to eight-year course leading to a professional engineer's license may cost up to $1,000. Most courses, however, cost from $100 to $500."

How can I get a list of accredited schools?

"By writing to me, Dr. Robert Allen, National Home Study Council, 2000K Street, N. W., Washington 6, D. C. We will send you one, free." -- from The American Weekly, June 11, 1961.

Our Students Speak-Cont. from page 15

to see your very beautiful city!

The Camera Craftsman deserves more than mere mention. Let us hope it can be expanded and published monthly. I am sure most of us receiving it would find no objection to a subscription price in line with the popular photographic magazines that carry so little of interest to repairmen.

It is my hope that I shall be able to visit the School again someday and renew acquaintance with all you wonderful folks!

C. L. Wilson
Mercedes, Texas

BELLOWS

Have we heard from you lately?

Thanks for the advice you have given me from time to time as I've needed it on several occasions. Thanks also for the constructive criticism you have extended me on some of my lessons, it was all greatly appreciated by me, I can assure you.

My next project now is working toward the purchase of a Motion Analyzer, then I'll have the finest of equipment for doing a large amount of work with the greatest of accuracy.

I've said it before, and I'll say it again, I certainly enjoyed working with you, and I will never hesitate to recommend you to any future students I may have the fortune to be able to advise.

Lorenzo Hall
Clearwater, Fla.

Since I am a photographer and not in the retail camera business, your course has not helped to increase my business--However, I personally feel that the instructions I have received have been invaluable.

Carl Catania
Thompsonville, Conn.

Since my last letter to you, I have done several more repair jobs and am doing fine, thanks to you and NCRS. But I think the nicest job I have done was one that I didn't do! "Sound a little fishy?" Well this chap came to me and insisted that his shutter and rangefinder were not functioning properly. I took his camera and checked it over thoroughly; it was in perfect shape. The trouble was with his inexperience and lack of knowledge of what his camera could and could not do. I went to great lengths to explain its functions to him and when I had finished he was quite happy and thankful for my sincere concern for his equipment. Just to see that he respected my judgment and ability was worth more to me than any fee I could have charged him. This was made possible by my excellent instruction from NCRS.

Walter Gilchrist
Ontario, Canada

You will work better when you see better with this new Binocular Magnifier. May be worn with or without eyeglasses. Leaves both hands free to work. Fine tolerance and precision work can be done easier, faster and more accurately using this equipment. With the Magni-Focuser you see an object in third dimension greatly magnified - with depth and clarity. It reduces eye-strain, thereby saving time, increasing accuracy and minimizing the chance of errors and accidents. The head-band is adjustable for your comfort. Normal vision may be resumed by slightly raising your head.

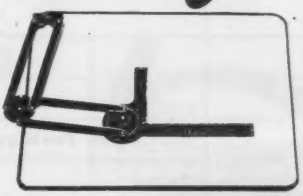
Model No 2	magnifies 1-1/2 times at	20"	Price $12.50
3	1-3/4	14"	12.50
7	2-3/4	8"	12.50
10	3-1/2	4"	15.00

No 13 and 17 are the same as No 3 and 7 with an auxiliary lens attachment which gives magnification of 4-1/4 and 5-1/4 respectively, with the right eye only.
Priced $17.50 each.

draftette

Complete with 10" x 13" drawing board . .	$5.95
Draftette instrument only . . . . . (Scale 3" x 5" – 6" arms – 180 degree protractor, Draftette completely assembled – ready for use.)	$4.95
Draftette with 4" x 6" scale and 11" x 17" Drawing board – Complete	$8.50
Draftette 4" x 6" scale alone	$2.00

draftette®
Complete with 11" x 17" drawing board only $6.50



NATIONAL CAMERA ServiShops
Box 174 • Englewood, Colorado

SERVISHOP PRODUCT GUARANTEE

When you purchase a ServiShops product, you are sure you're getting the best of equipment. Every product advertised in the Camera Craftsman carries three warranties.

First, you have a ten-day return for refund privilege. If, for any reason, you're not satisfied, you can return your order within 10 days of purchase, for a full refund.

Second, all materials and workmanship of NCRS manufactured products are guaranteed by NCRS for one full year. NCRS will replace any parts or components which might become defective in normal use, if returned to the factory, transportation charges prepaid, within one year of original purchase.

Third, all products and parts handled by NCRS are guaranteed by the individual manufacturers of those products.

National Camera Repair School further guarantees to check and service any ServiShops product no longer within the warranty period, at nominal charge.

NCRS ORDER BLANK Date _____ 19__

You can order any product advertised in the Camera Craftsman. All products carry the NCRS Return Privilege Guarantee -- Satisfaction or return in 10 days for complete refund!

Shipments are F. O. B. Englewood (Denver), Colo.

Acct. No. _____

Name _____

Street _____

City _____ State _____

How shall we ship? How will you pay?
Parcel Post Cash
Railway Express C. O. D.
Other _____ Other _____

Quantity	Name and Description	Price
	minimum Postage	**.30**
	Total	

Minimum Order - $2.00 Signature _____

FREE . . .

CAMERA CLINIC . . .

Mr. Robert S. Wilson, of the Wilson's National Camera Servishops will be at our Store all day, Friday, June 23rd. He will offer Free estimates and do minor repairs to cameras. Bring your Camera in for a free check-up and get it ready for the 4th of July.

TYPES OF SERVICE . . .

1. General repairs on still and movie cameras.
2. Built-in synchronization for practically all cameras.
3. Electronic analyzation of shutter speeds and internal synchronization.
4. General repairs on all still and motion picture projectors.
5. Flash repairs.

SPECIALISTS ON COMPUR AND COMPUR TYPE SHUTTERS

ROANOKE PHOTO FINISHING CO.

THE CAMERA SHOP Second St. at Luck

Customer Parking Adjacent

CAMERA CLINIC

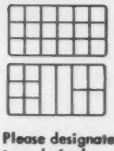
Robert S. Wilson of Wilson's National Camera ServiShops reports that a camera clinic he recently conducted in Roanoke, Virginia was very successful. We are reprinting the advertisement he used as it may be of help to others.

Mr. Wilson is currently considering the purchase of a shop or associating himself with an established shop. Anyone interested in contacting him may do so by writing the Editor, The Camera Craftsman, Box 174 Englewood, Colo.

Handy PLASTIC BOXES

These crystal-clear boxes, 8-1/4" x 4-1/4" x 1-1/4" are molded of clear polystyrene, a light hard plastic which retains its polish well. Very handy for storage of nuts, bolts and even fishing tackle.

3 for $2.00
75¢ each



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Order from:

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Box 174 • Englewood, Colorado

request for information . . .

NATIONAL CAMERA REPAIR SCHOOL

Box 174
Englewood, Colorado

I am interested in the opportunities and advantages of a career in Camera Craftsmanship. Please furnish me with complete information about your training program.

Name_____ Age _____

Street _____

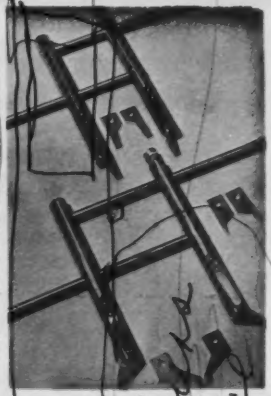
City _____ State _____

If you have a friend or relative who may be interested in the money making opportunities tha exist today in the camera repair field, have him or her fill out this coupon and mail it to the National Camera Repair School Box 174, Englewood, Colorado

751-1

MULTISPAN WRENCH

$8.50



Here is the precision spanner wrench designed especially for optical and camera work. It will serve you economically, for the tool accepts replaceable and interchangeable tips. Quickly adjustable from 0" to 4" (even more with proper tips), you lock the setting firmly with a single motion. The MultiSpan's versatility is unmatched because of the many varieties of tips you can use. You can instantly snap a tip for almost any application into one of two positions. Get a complete set of tips which you can use in pairs or in combination with each other.

Blanks with the tip unground are also available. These tips are already heat treated, and plated. You can grind the blade to the required shape for many of the hard-to-get-at retaining rings. Prices shown are per pair.

751-2	Tips, straight, flat, ground 1.60	751-2u	Tips, straight, flat, unground ... 1.50
751-3	Tips, straight, pencil point 1.60	751-3u	Tips, straight, point, unground ... 1.50
751-4	1/8" offset, flat, ground 1.80	751-4u	Tips, 1/8" offset, flat unground ... 1.50
751-5	1/4" offset, flat, ground 1.80	751-5u	Tips, 1/4" offset, flat unground ... 1.50
751-6	3/8" offset, flat, ground 1.80	751-6u	Tips, 3/8" offset, flat unground ... 1.50

751-15 A Special Spanner Wrench for removing narrow shutter retaining rings on the Retina and Karat cameras

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